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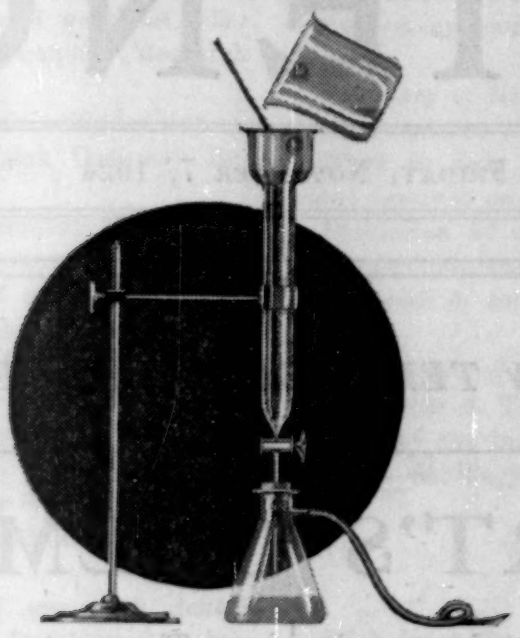

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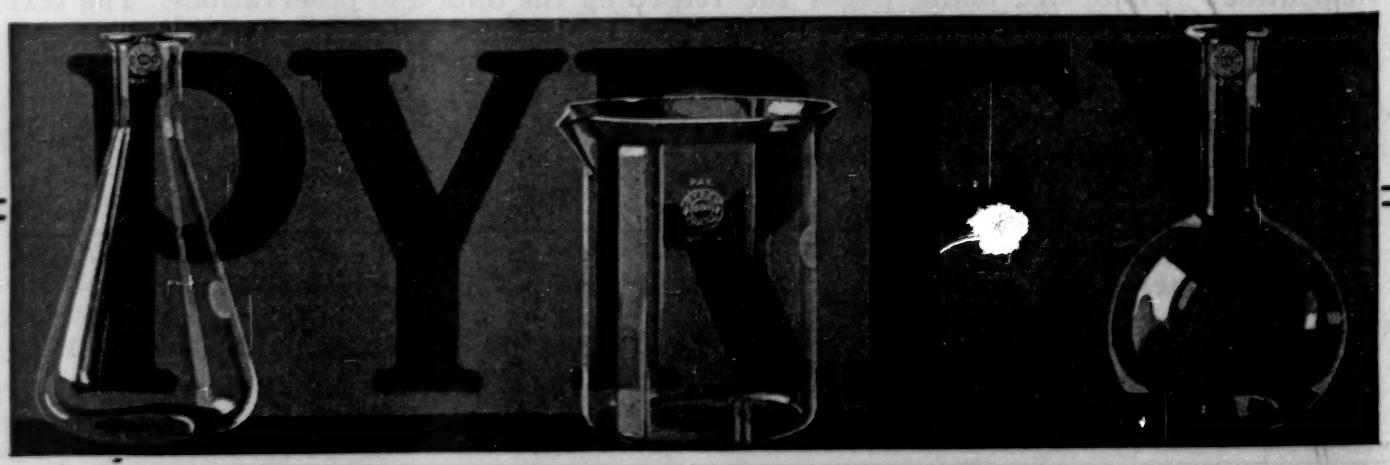

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T. MITCHELL PRUDDEN, 1849–1924

DR. T. MITCHELL PRUDDEN was one of the group of advisers of Mr. Rockefeller and his associates consulted on the creation of an institution for the investigation of disease, and he became one of the original members of the scientific board to which was entrusted the conduct of The Rockefeller Institute for Medical Research when founded in 1901. Dr. Prudden was chosen first vice-president of the board and first chairman of its executive committee, offices which he continued to hold until his recent death. Although repeatedly pressed to accept the presidency of the board, he resolutely refused the election. The services rendered to the institute by Dr. Prudden far exceeded in scope and devotion the official positions which he held.

Dr. Prudden's professional life in New York covered more than forty years, and was spent in large measure in forwarding the public welfare. But so self-effacing was he that it was only to his family, intimate friends and a coterie of his professional associates that the nature, variety and extent of his public services became known. The aid he rendered to the departments of health of the city and state of New York is written large in their history; as a student and teacher of cellular pathology and bacteriology—two branches to which modern medicine owes very much of its recent advances—he ranks among the leaders; and many of his pupils now carry on the high standards and wholesome traditions which he helped to establish in the country. After his retirement from the professorship of pathology at Columbia University in 1909, Dr. Prudden continued to exercise his humanitarian impulses and his interest in medical research in connection with the public health council of the state department of health, of which body he was an original member, and with the Rockefeller Institute to which he came daily and participated in many of its activities. To his many other gifts, Dr. Prudden added an exceptional administrative capacity and executive acumen. Hence he served many important enterprises of philanthropic and scientific nature during their formative and stressful periods in a manner which contributed valuably to their ultimate successful issue.

Dr. Prudden possessed a natural habit remarkably straightforward and elevated. It is doubtful whether many persons casually penetrated an exterior superficially somewhat austere. But to the number, by no means small, of persons admitted into the inner circle of his personality, he exhibited a nature peculiarly sympathetic, sensitive and simple and a heart of rare

warmth and richness. His scientific ideals were high, sometimes it seemed almost unapproachably high. And yet he produced work of his own, through his pupils and by stimulation from many others; and no one put a higher value on something real achieved than did Dr. Prudden.

Fortunately, Dr. Prudden has left behind materials suitable for a brief sketch of the outstanding incidents of his life, for the use of which I am indebted to his sister, Miss Lillian E. Prudden.

T. Mitchell Prudden was the fourth son, in a family of four sons and one daughter, of the Reverend George Peter Prudden and Eliza Ann Johnson. The father, a Congregational clergyman, was the direct descendant, seventh generation, of Reverend Peter Prudden, one of the founders of New Haven colony in 1638. It is of some interest to record that the Reverend Peter Prudden later separated from the New Haven colony and established the Milford Church in 1639.

Dr. Prudden was born in the parsonage at Middlebury, Connecticut, on July 7, 1849. He died in New York City on April 10, 1924. His early life was passed in the parsonages at Middlebury, Southbury and Watertown, Connecticut; for a brief period on a farm belonging to the family, and at New Haven, Connecticut; the last 45 years were spent in New York. The early period is made up of the common heritage, varied only by circumstance, of healthy and happy childhood. One point is stressed, namely, that in the household there existed "sympathetic realization of the youngster's point of view, and for the necessity of amusement and initiation into knowledge and familiarity with things worth while." The strenuous period with many vicissitudes came with adolescence; the father's anti-slavery proclivities aroused vehement opposition, which in turn served to accelerate a decline of health already apparent, and this led to his retirement from the pulpit, although for a time preaching was continued in other places. The eldest son, Henry, of strong literary tastes and an eager desire for a college education, "courageously and generously" entered business in New Haven and later prospered. In 1866, when Mitchell was 17, a place was found for him in Henry's establishment, where, besides sweeping and dusting, he was initiated into the vagaries of salesmanship and the intricacies of bookkeeping. The duties proving irksome and the youth perhaps ill adapted, the connection was dissolved and a year or more later, after a period of indefinite happenings, Mitchell embarked upon his first real adventure—an index perhaps of many subsequent ones pursued in Europe and in this country in wooing the new cellular pathology and bacteriology and harnessing them to an outworn and changing medical creed, and in explorations of the Great Western Plateau. This first venture included a cruise in Long Island Sound in a Menhaden fishing schooner, a mutiny among the crew, the landing of the passengers on the rocks at Stratford Light and a walk back to New Haven.

In 1866 the start, with the financial backing of Henry, was made towards college and the sciences. A preliminary year was spent at Wilbraham Academy, and the Sheffield Scientific School was entered in 1869 under a Connecticut state fellowship which provided free tuition during the undergraduate years. The first year courses in physics, chemistry, mathematics, German and English were followed and the goal of medicine was decided upon. As there was at that time no combined instruction provided in zoology, botany, organic and physiological chemistry, Prudden and his friend Russell, who already sensed their importance for a medical career, appealed to the faculty with such success that a course called "The biological course in preparation for medicine" was instituted. The class started with the two friends as sole attendants. This proved no disadvantage, as the earnest young men "were invited for special, advanced work in botany into Eaton's herbarium at his house; they were placed in Johnson's private laboratory for physiological chemistry; they worked rather as assistants than as students under the eye . . . of Verrill and Sid. Smith in the old 'Bug Lab' (alias zoological laboratory)." The two concluding years were full of action: the collection of plants and animals; scouring of land and sea about New Haven; studies with Whitney, Lounsbury and Gilman—all combining to arouse a profound and abiding interest in the now aspiring Mitchell. In view of the facile pen which he later wielded, it is interesting to note that Prudden received honorable mention in English composition under Lounsbury.

It was in the last spring vacation of 1872 that Prudden and Russell chartered a yacht and "taking along a few choice spirits, made a week's dredging expedition down the Sound. They dredged off Watch Hill and Newport, went over to Holmes' Hole (Woods Hole), Edgartown, had a glorious adventure, and brought back much plunder, establishing new habitats for several marine invertebrates. . . . This was the first dredging done about Woods Hole and its neighboring waters."

Progress had now come with celerity. During the last term in the Sheffield Scientific School, Prudden was selected to substitute for Professor Mixter in freshman elementary chemistry. "There were weekly lectures with an experimental lecture, a practicum for the whole class once a week, and recitations." Study had also been begun at the Yale Medical School under the old two-year lecture system; and, at the same time, Prudden served as secretary to the faculty of the Scientific School. The M.D. degree was awarded in the autumn of 1875, the spring

months having been spent in New York in the study of pathology under Dr. Francis Delafield. A hospital interne year, divided between medicine and surgery, followed at the New Haven Hospital. As the hospital did not then provide a laboratory for clinical tests, Prudden brought his New York experience to bear by setting up a small one in a basement room. It should now be apparent to one looking backward over Prudden's career that the laboratory instruction at the Sheffield Scientific School served to discontent him with the system of didactic lectures in vogue at the Yale Medical School, and drove him to study pathology under Delafield in New York, which experience in turn determined his going abroad for further training and thus had much to do in shaping his subsequent course.

The lack of opportunity to pursue adequately practical laboratory courses of instruction in the fundamental branches of medical science in the United States led Prudden, immediately after the completion of his interneship, to seek this opportunity abroad. He naturally turned toward Germany and chose Arnold and Heidelberg as his immediate goal. There still exists the letter, dated September 10, 1876, in which Professor Arnold informs Prudden that a place had been reserved for him in his laboratory and that he does not accept fees. He, however, states that a registration fee of about 10 marks is required. During the winter semester, therefore, of 1876–1877 Prudden followed the lectures and laboratory courses under Professor Arnold and his associate, Dr. Thoma. Subsequently he visited other medical centers, including Vienna, and worked in other laboratories, returning to New Haven after a period of two years of study abroad.

In 1879 there appeared in Virchow's Archiv the paper, "Beobachtungen am lebenden Knorpel," which embodied the results of the main laboratory study pursued by Prudden under Arnold's and Thoma's direction. The study is perhaps more significant to-day than it was at that time. In brief, it represents the endeavor to trace the effects of injurious agencies on living cells while still under control of normal environmental conditions. The fixed cells of the episternal cartilage of the frog were the objects chosen for observation and experiment. A clever device was arranged by which that quite transparent structure could be viewed for hours directly under the microscope, while still in vascular connection with adjacent parts. The chromatin network of the nucleus was discerned and shown to be a preformed structure; variations in cell forms and content, inducible at will, were seen to appear and disappear according to the influences to which the tissue was subjected; the important fact that dissolved dyes do not color the living, but do stain the dead nuclei, was clearly shown, as was the fact that it is particulate, not dissolved dyes, which are ingested by living cells. Just now when the growth of cells *in vitro* is affording so remarkable an opportunity to unravel the intricacies of cell generation and degeneration, and vital staining is clearing up so many dark and disputed questions of cell origin and fate, this early, spirited investigation of Prudden may be regarded as a pioneer undertaking in observing what actually goes on in living cells as distinguished from the inferences drawn of the processes concerned, from the appearance of dead tissues, fixed in chemicals and stained in section. Prudden sums up his findings in the following important paragraph:

> But it seems to me particularly significant that it is possible to observe under the microscope, on living cartilage tissue, the processes of contraction and the formation of vacuoles; and that it is possible thus to determine whether and under what conditions such changed cells return to the normal state or whether they undergo degeneration and die. The observations made with reference to the behavior of living and of dead cartilage cells in response to dyes also seem to me noteworthy, because we thus learn that only the nuclei of the latter stain homogeneously. We are, therefore, in a position to distinguish whether cells are dead or living, and can thus exclude their participation in regenerative processes.

It was in 1879 also that Prudden abandoned the idea of the practice of medicine and adopted the career of full-time teacher of pathology in New York. This momentous decision was not something made without forethought and perturbation of spirit.

When Prudden came home from Europe, full of enthusiasm to introduce into the lore and training of medicine the laboratory and special research study and teaching of normal histology, pathology and pathological physiology, as related to medicine, with all of which he had been especially engaged in various places during his two years abroad, he was chagrined to find none of the authorities at the several medical schools whom he consulted and the few leading practitioners of medicine with whom he talked, seemed to care about these things as special subjects of knowledge or training. There were chairs of pathology and the practice of medicine, but no chairs of pathology as a special practical theme, and no one saw any occasion to establish them. . . . Thus it was that after vain efforts to get a place to work at pathology at any of the medical schools, even as a volunteer, Prudden finally came back to New Haven, opened an office and started to practice.

However, beneath this placid surface of complacence in the medical schools, with things as they are, a new movement was beginning to make itself felt. Dr. Welch had recently become established at Bellevue Hospital Medical College in a laboratory adjoining the dead house at Bellevue Hospital and was attracting students to his demonstrations and lectures from all three medical schools in the city. This notable

success led the Alumni Association of the College of Physicians and Surgeons to propose to set up a pathological laboratory, and Dr. Delafield turned to Prudden, to whom was offered the position as assistant.

The letter (Delafield's) was carefully weighed as the turning point in an opening career, and finally the offer was declined. The letter expressed regret that financial and other circumstances did not seem to justify the writer in cutting adrift from his old associates and a modest living as a teacher and practitioner in New Haven. . . .

This letter ready for posting was held over until morning. During the watches of the night, however, the spirit of adventure, or the lead of a strong impulse of devotion to the advancement of science, led to the destruction of the letter and an acceptance of Delafield's offer and the arrangement of a visit to New York.

This momentous decision, not only for Prudden himself, but, as it proved, for the future welfare of pathology in the United States, was communicated promptly, it would appear, to Professor Arnold, since in a letter from him dated November 15, 1878, I glean the following:

Your letter pleased me greatly because I am convinced that the position you have assumed will assure you a future. From my knowledge of you, I am, I believe, justified in saying that you will not now easily be diverted from the goal of a scientific career. There is no doubt in my mind that your institute will be a success. The fact that it is small and has only moderate means at its disposal is not important. Some time ago, our German pathological institutes, with the exception of a few, were very bad; now they are being replaced by good ones. But I know from personal experience it is possible to work in even a small institute.

All that Professor Arnold prophesied came true, even to the lean years and the apathy on the part of the older practitioners and teachers in the medical school. But when the College of Physicians and Surgeons was built on West Fifty-ninth Street, opposite the Roosevelt Hospital and adjoining the Vanderbilt Clinic, its chief glory consisted of the splendid group of laboratories, long unequalled, housing the significant department of pathology and bacteriology presided over by Dr. Prudden.

But in 1878–1879, when these beginnings were being laboriously and painfully made, there existed in English no text-book which fairly represented the subject of pathological anatomy as conceived and taught in Europe, especially in Germany. Prudden conceived the notion, even before he returned from his European trip, of translating the brief but excellent work of Perls, and with this end in view, he carried on a correspondence with the author, whose consent he obtained, and then with American publishers, who declined to undertake the printing. From his letter to Professor Perls, ending the series, I abstract the following:

I have been delayed in writing to you, as I promised before leaving Germany, on account of the tardiness of several publishers in answering my communications.

I regret to inform you that none of our best publishers in New York or Philadelphia are willing to undertake the publication of the work at present. The times are bad and the pathological works which have been translated have not been financially successful, and hence they are unwilling to assume this responsibility now.

I regret extremely that it can not be added to our English works at once. I think it possible that it may be done after a time, but at present it seems impossible.

But the large gap which Prudden tried unsuccessfully to fill at the outset of his career with the translation of Perl's pathology he was destined to fill later with a more ambitious and significant work of his own with Delafield. The first edition of Delafield and Prudden's text-book appeared in 1885. As an index of the change in sentiment regarding pathology which had taken place in half a dozen years in America and the standing it came to have may be cited the fact that a second edition was called for within the year. Twelve editions have now been published, each more complete and comprehensive than its predecessor. There is not a modern student or practitioner of medicine who has not fed on its authoritative contents. Dr. Delafield dropped out of the work as part author after the seventh edition. From the tenth edition on, Dr. Francis C. Wood, a pupil of Prudden's, has cooperated in preparing the new volumes. The work as a whole is a tribute to Prudden's grasp of the principles and the practical details of general and special pathology and bacteriology; and among its distinguishing characteristics are charm of style and precision of language, which only felicity and mastery of English diction could achieve.

The great wave of interest in bacteriology, set in motion by the remarkable work of Pasteur and of Koch, and which broke over the world with the announcement of the discovery of the microbes of tuberculosis, cholera, typhoid fever and of the means of preventing rabies, led to a quick response from Prudden who sensed the part the new science would come to play in pathology and in preventive medicine. Early in 1885, therefore, he planned to return to Germany to study, if possible, under the master Koch himself. That he at once enlisted the good offices of his old teacher in this ambition is shown by a letter under date of March 29, enclosing a note from Koch himself, written by Professor Arnold. Koch's note states that "at the moment it is not possible to accede to the request of Dr. Prudden, as the few available places at the Gesundheitsamt have already been assigned for some time ahead." He adds that "a hy-

gienic laboratory will be opened within the next few months, and I expect to give a bacteriological course there. I would suggest informing Dr. Prudden of this opportunity." Arnold's covering letter to this significant enclosure suggests that a preliminary course be taken with Heuppe in Wiesbaden or Frobenius in Munich. He adds, "I was delighted with your letter, because I gather from it that everything is going well with you, and because you give me the hope of seeing you soon." That Prudden's desire to study under Koch was finally achieved is shown by a paper, written in 1885, in which he describes the method of teaching carried out by him.

Thus the course in the study of bacteria, of one month's duration, in Koch's laboratory was brought to an end, and the writer can not refrain from remarking that the calm, judicial mind of Dr. Koch—the master worker in his field—his marvelous skill and patience as an experimenter, his wide range of knowledge and his modest, unassuming presentation of his views are all calculated to inspire confidence in the results of his own work, to stimulate his students to personal exertion in this field and to lend certainty to the already widespread hope that ere long through the resources of science we shall be able to cope successfully with those most terrible and fatal enemies of the human race—the acute infectious diseases.

Prudden became, therefore, the instrumentality through which the new bacteriology was brought to New York; research was begun and courses of instruction in the subject were at once offered to students; and the tenets of the new science were made practically potent through the influence which Prudden exerted upon the officials of the city department of health and by a well-considered newspaper campaign carried out anonymously over a period of years. It is no accident, therefore, that the department of health of New York presented itself as well advanced in applying to public health measures the teachings of the new hygiene.

The large range of Dr. Prudden's intellectual activities can be gleaned most easily from the list of his published papers and books which, from 1879 to 1914, cover about 100 major titles. The greater number of the papers and books relate naturally to his special field of inquiry, namely, pathology and bacteriology, in the widest sense. The articles and books on American ethnology form a thing apart and show how readily Prudden might have led in archeology, as he did in pathology. His pen was a facile instrument which he could turn at will to the description of detailed and abstruse phenomena or the revealing of fascinating and romantic happenings in the life of the bacteria, the conquest of disease, the past of American aborigines, or indeed any theme which engaged his interest and his thought. His delightful booklets, "The Story of the Bacteria" and "Dust and Disease," were more than messengers of light to the medical profession; they were written in such simple and delightful style that they were read with the absorption of romance by many lay persons, and contributed a large share to that popularization of authentic knowledge upon which the modern practice of sanitation has come to be built. But, as with every scientific man, the most enduring productions are the results of his own efforts to extend the bounds of knowledge; and in that endeavor, Dr. Prudden himself labored through many years and inspired the labors of many others. There stand to his credit and that of his pupils many conspicuous pieces of finished work.

The adventurous and pioneer Prudden did not fail after arduous days to bring back his ship laden with a rich freight of humanitarianism and science. Let this be his monument.

SIMON FLEXNER

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH

VASECTOMY AND REJUVENESCENCE

THE skepticism manifested by many biologists concerning the results of vas deferens ligation or vasectomy in producing rejuvenating effects seems abundantly justified from both old and new researches. The Steinach operation has commanded considerable interest because of its rejuvenescence claims, *i.e.*, by the remarkable character of these reported effects of restoring youthful vigor. The explanation usually offered is to the effect that there is produced degeneration of the spermatogenic cells with attendant hypertrophy of interstitial tissue. The latter supposedly causes the rejuvenescence. The primary atrophy of the spermatogenic cells is said to be followed by a subsequent regeneration which relieves the animal of the temporary sterility produced by the ligation.

A review of the literature on vasectomy which has been accumulated since the early eighteen hundreds is especially interesting. Hunter,[1] Cooper,[2] Gosselin[3] and Curling[4] were among the earliest of those interested in pathological change in the testes, epididymis and vas deferens. Part of their interest lay purely in the field of pathological findings together with a

[1] Hunter, "Hunter's Works," Ed. by Palmer, Phila., 1841.

[2] Cooper, "Observations on the Structures and Diseases of the Testis." London, 1845.

[3] Gosselin, Arch. gen. de Med., 1847, S. 4, Vol. XIV, p. 408; "Nouvelles Études sur l'obliteration des voies spermatiques et sur la stérilité consecutive à l'épididymite bilaterale." Arch. gen. de Med., S. 5, Vol. II, p. 256.

[4] Curling, "On the Diseases of the Testis," Phila. 1866.

speculative interest in the consequences to the testes of the absence of the vas deferens or of its occlusion. This interest is typified in Curling's experiments upon three dogs and one cat. He found that vasectomy of sixty days to eight months was followed by distension of the epididymis with testicular products, including spermatozoa, and that no changes took place in the testicle proper. Such experiments were looked upon as confirmation of observations made from human dissections where the vas deferens was either prenatally absent or had been occluded for a long time with no marked effect upon the testis. Curling cites a number of such dissections in his book on "Diseases of the Testis."

A little later this interest was increased in an endeavor to find a relief for pathological hypertrophy of the prostate. Some of the earlier workers referred to above were interested in this phase of the study, but the writings of Spangaro and of Wallace are especially to this point. Spangaro[5] found spermatozoa in the testes of three men, twelve days, six months and two and one half years after vasectomy, while Wallace[6] concluded from a review of literature and from a series of experiments on six dogs and one kitten that the growth of the testicle and its function of producing spermatozoa is independent of the integrity of its vas.

Experimental biologists had likewise pursued this line of investigation and had obtained similar results. Brissaud[7] used rabbits as experimental material and found that the epididymis became enlarged because of the accumulation in it of spermatozoa which the testis continued to produce. Shattock and Seligman[8] found that vasectomy on sheep for a period of a year or more produced no degenerative effects in the testes. We thus find in the literature up to this time a general and remarkable unity of results. These early workers found that occlusion of the vas deferens produced no pathological changes in the testis proper. The reader should note the diversity of material studied: rabbits, cats, dogs and human tissue.

[5] Spangaro, "Nel Testicolo Senile conduce la ligatura del dotto deferente all' atrofia dell' orgeno?" *Lo Spermintale,* 1903, an 57, F3.

[6] Wallace, "The results of castration and vasectomy upon the prostate gland in the enlarged and normal condition." Trans. Path. Soc. of London, 1905, Vol. LVI, p. 80.

[7] Brissaud, "Effects de le Ligature du Canal Deferent," Arch. d. Physiol., S. 2, Vol. VII, p. 769.

[8] Shattock and Seligman, "Observations upon the acquirement of secondary sexual characters, indicating the formation of an internal secretion by the testicle," Proc. Royal Soc. of London, 1904, Vol. LXXIII, p. 49.

At about this same period two French biologists, Ancel and Bouin,[9] using rabbits as experimental material, reported that degeneration of spermatogenic tissue always took place if the ligation was continued long enough. They supported their contentions by studies on cryptorchid testes of pigs and showed that the vasectomized and cryptorchid testes were almost identical. These experiments were used by Ancel and Bouin as a link in their proof that the interstitial cells produced the testicular hormone. Steinach confirmed and extended these experiments, claiming to produce by them rejuvenescence. He used rats as experimental material and claimed that when old, senescent animals were vasectomized they showed definite signs of rejuvenescence within twenty-one days. He contended, as did Ancel and Bouin, that the spermatogenic tissue of vasectomized testes underwent degeneration, while the interstitial cells hypertrophied. He then argued that sex activity increased through the enlargement of the "puberty gland"—the interstitial cells. Sand, Tiedje and Lipschutz quickly took up this work on rabbits, rats and guinea pigs. These men, as did Steinach, found degenerative changes in *some* testes, while *in other cases the testes were normal.* Steinach[10] and Tiedje[11] explained these irregularities by stating that degeneration always took place, but that after some time regeneration followed. Sand[12] and Lipschutz[13] explained the irregularities in their experiments by stating that some of the animals used were immature when operated upon and that these alone did not suffer degeneration of the germinal tissue. It is interesting to note that in one report by Sand,[14] in which he presents fifteen vasectomy experiments only two had degenerated testes.

Most of these workers were ignorant of the earlier work or deliberately ignored it. Beginning with Ancel and Bouin, they all used rodents in their ex-

[9] Ancel and Bouin, "Recherches sur les Cellules Interstitielles du Testicule des Mammifères," Arch. d. Zool. Exper., 1903, S. 4, Vol. 1, p. 437.

[10] Steinach, "Verjungung durch experimentalle Neubelebung der alternden Pubertatsdruse." Arch. f. Entwickmeck, 1921, Vol. XLVI, p. 557.

[11] Tiedje, "Changes in testes after ligation." *Deutsch. Med. Wockenschr.,* 1921, Vol. XLVII, p. 352.

[12] Sand, "Études exper. sur les glandes sexuelles chez les mammifères," *Journ. of Physiol.* 1921, XIX, pp. 305, 494 and 515.

[13] Lipschutz, "The so-called compensatory hypertrophy of the testicle after unilateral castration." *Journ. of Physiol.,* 1921, Vol. LV, p. 451.

[14] Sand, "Expériences sur la resection du vas deferens," *J. de Physiol. et de path. gen.,* 1923, XIX, 494-503.

periments. It remained for the writer to show that their choice of experimental animals was particularly unfortunate (Oslund).[15] In these animals (rodents) the testes are free to move from the scrotum into the peritoneal cavity and vice versa. Following ligation or resection of the vas deferens, the testes are often retained in the peritoneal cavity by adhesions. It is this artificial cryptorchidism that causes degeneration of the germinal epithelium. Vasectomy alone does not cause such degenerative changes. In order to carefully test this point several extensive series of experiments of from fourteen days' to ten months' duration were performed upon rats and guinea pigs. Degeneration of the germinal epithelium did not follow ligation of the vas deferens in any experiment of short or long duration where the testes were known to reside in the scrotum following the operation. Degeneration did take place in every experiment where the testes, either uninjured or vasectomized, were retained in the peritoneal cavity.

In a later paper it was shown that vasectomy on dogs does not produce degenerative changes in the testis or hypertrophy of interstitial cells (Oslund).[16] In rodents the inguinal canal is patent, while in carnivora it is closed and vasectomy results are not complicated by the possibility of accidental cryptorchidism produced by the operation. Care was taken to eliminate all extraneous factors, such as diet and confinement. Following closure of the vas deferens, there is an accumulation of testicular products in the epididymis which leads to its distension. An equilibrium between rate of spermatogenesis and absorption of this material is quickly reached, and no degeneration of seminiferous tubules takes place.

A detailed review of the literature bearing upon vasectomy on animals having a closed inguinal canal strikingly emphasized the above points. From such a review it has been pointed out that vasectomy on sheep from seventy-six days to one year, on dogs from sixty days to four years and on man from twelve days to four years has produced no testicular changes (Oslund,[16] p. 117).

What, then, of interstitial cell, "puberty gland," hypertrophy? In a recent paper it has been shown that unless there is degeneration of the germinal epithelium, interstitial cell hypertrophy does not take place (Oslund).[17] The interstitial cells occupy the spaces betwen the seminiferous tubules. Only when these tubules atrophy are these spaces increased in size. It is then quite evident that increase in interstitial cell mass, either in cell number or in cell size, can take place only when these tubules atrophy. When an increase of interstitial cells takes place it is largely regulated by tension and pressure within the testis. Compensatory hypertrophy of interstitial cells is very probably a misnomer and not a reality (Oslund,[17] p. 595).

It then appears that vasectomy causes no changes in the testicle proper. The epididymis becomes somewhat distended with testicular products. There results no degeneration of germinal epithelium and no interstitial cell hypertrophy. The changes claimed to have resulted from vasectomy appear to have been produced by subsequent influences rather than by vasectomy itself.

The theory of rejuvenescence at present is based upon a necessary interstitial cell hypertrophy. Ligation of the vas deferens does not produce such a hypertrophy. Vasectomy, therefore, can not be looked upon as a method of causing rejuvenescence.

ROBERT M. OSLUND
VANDERBILT MEDICAL SCHOOL

[15] Oslund, "Vasectomy on rats and guinea pigs," *Am. J. of Physiol.*, 1924, Vol. LXVIII, p. 422.

[16] Oslund, "Vasectomy on dogs," *Am. J. of Physiol.*, 1924, Vol. LXX, p. 111.

THE HARVARD SUMMER SCHOOL OF GEOLOGY

RECENT mention in SCIENCE (August 22, 1924) of the summer school of geology being conducted by Professor Grant, of Northwestern University, moves the undersigned to offer the following account of the Harvard school which was held under Professor Shaler, in camp, on Cumberland Mountain, near Cumberland Gap, on the Kentucky side, in June, July, August and September, 1875. This antedates Professor Grant's camping school 49 years and shows that the idea of a camping school of geology is not new in this country. The names of some prominent men connected with this school or who have since become prominent, especially in science, and some personal reminiscences may not be without interest.

The writer, born within ten miles of the first pig-iron furnace in America, on the trail left by Spotswood and the Knights of the Golden Horseshoe, after leaving the Virginia Military Institute, Lexington, Virginia, reached Kentucky on St. Patrick's day, 1874, when Professor Nathaniel Southgate Shaler, of Newport; Ky., and Harvard College, was directing the reinstated Kentucky Geological Survey begun by David Dale Owen in the early fifties. Professor Shaler conceived the idea of holding the Harvard summer school of geology in connection with the work of the survey the next summer.

Camp Harvard, on the Harlan C. H. road, at the foot of the Pinnacle, some mile or more west of Cum-

[17] Oslund, "Interstitial cell hypertrophy," *Am. J. Physiol.*, 1924, Vol. LXIX, p. 589.

berland Gap, was reached on July 4 of that year. In the party there were some 15 or 20 Harvard students who reached Norfolk, Virginia, by water, thence to Morristown, East Tennessee, then on foot to the camp.

The officers of the camp (all members of the Kentucky Geological Survey) were Professor N. S. Shaler, state geologist, Jno. R. Proctor, camp master, Philip N. Moore, of Missouri, geologist, Chas. J. Norwood, of the same state, geologist, A. R. Crandall, of New York and Wisconsin, geologist, Lucien Carr, of St. Louis, archeologist, J. H. Talbutt, Lexington, Kentucky, chemist, and James Mullen, of Lexington, Kentucky, photographer. Colonel W. C. P. Breckinridge, wife and family of four children, together with Mrs. Pickett and Misses Desha and Kinkead, were with us for the summer. With us also were Professor Shaler's wife and little daughter, and Mrs. A. R. Crandall, also Colonel Gordon McKay, millionaire of Boston, inventor and patentee of the McKay stitch, and Hon. John D. White and sister. The school was 40 miles from a railroad, on the east or Tennessee side, and 75 on the west or Kentucky side; almost entirely inaccessible by means of wheeled vehicles, but wonderfully located for the study of geology, as there was immediately by an exposure from the Upper Coal Measures to the Potsdam Sandstone, finely exposed, with faults, anticlines, synclines, etc., well displayed. There were between 30 and 35 men, the majority of whom were students under Shaler at Harvard, who were the basis of the camp. Of that number the following have done professional work, and some of them still are doing it:

Wilbur F. Barclay, Russellville, Kentucky.
Malcolm H. Crump, Bowling Green, Kentucky.
Wm. M. Davis, Cambridge, Massachusetts.
J. W. Fewkes, Washington, D. C.
Jno. Alva Myers, W. Liberty, West Virginia.
Jno. Murdock, Cambridge, Massachusetts.
H. H. Straight, Oswego, N. Y., father of the late Major Straight.
J. E. Todd, Tabor, Iowa.
R. H. Wildberger, Clarksdale, Mississippi.
J. S. Diller, Washington, D. C.
Geo. H. Eldridge, Cape Cod, Massachusetts.
S. S. Green, Swarthmore, Pennsylvania.
W. M. Linney, Harrodsburg, Kentucky.
H. A. Mertz, Bethany, West Virginia.
Richard Parsons, Plymouth, Ohio.
W. L. Titus, So. Amesbury, Massachusetts.
F. Jackson, Boston, Massachusetts.

Among the visiting instructors were Dr. Safford, state geologist of Tennessee, Mr. Kerr, state geologist of North Carolina, and David Starr Jordan, the star fisherman of the occasion.

The students were provided each with a steel hammer weighing some four pounds, together with note books, suited to the work, compass, clinometer and a bottle of hydrochloric acid for distinguishing the difference between ordinary limestone and dolomite (the writer has his tools yet). Parties of four to six were sent out with some one of the faculty for one to several days, with instructions to make sections along the road from the Gap on one side as far as Morristown, Knoxville, Speedwell, also along the mountains on the Kentucky side for the outcrops of coal which abounded in that vicinity. Reports were made on the return which were criticized in public by Shaler under a large lecture tent that formed a conspicuous portion of the camp.

Lectures were given every night by Shaler or some member of the faculty, with illustrations on blackboards, etc. The students were housed in several large tents, provided with cots, water being very convenient from a large spring near by; meals were supplied and served in another tent of considerable size and were prepared by the most important individual of the camp, known as Jim, very black, from Frankfort, Kentucky, with an assistant, even blacker, if possible, who knew how to fry chicken and make the best corn-bread, which even the New Englanders learned to love. Colonel McKay occupied a large private tent, with his original shoemaker's bench and kit of tools, with which he frequently came to the rescue of the unfortunate whose footgear needed attention.

There was also a party of topographic engineers in charge of William Byrd Page, a distinguished graduate of the Virginia Military Institute, of Norfolk, Virginia, with his several assistants. He had been delegated from the state survey to head a party of the U. S. Coast and Geodetic Survey, who established a base line in Yellow Creek valley where Middleboro now stands; this was probably the first work of the kind done by the state and nation in Kentucky.

The camp broke about the second week in September into many small groups, each headed by some competent instructor, who went in various directions, the writer, with Wildberger, Barclay and Straight, accompanied by Dr. Safford, passed through East Tennessee to the North Carolina line, where we met Mr. Kerr, state geologist of North Carolina, and by him were introduced to the very difficult stratigraphy of the pre-Cambrian formations, up and along the French Broad, via the Hot Springs, where we met the widow and young daughter of Stonewall Jackson, thence to Asheville, where Mr. Kerr left us and we four pursued our way up the Swannanoah to Grey Eagle at the foot of Mt. Mitchell, thence the

next day to the top where we slept in the rain with a party of mountaineer cattle-herders, who kept a roaring fire during night. Here our mountain guide departed and left us to the mercy of the very indistinct blazes on the trees; we ran across Big Tom Wilson, who found the body of Dr. Mitchell, whose life was lost by falling over a precipice into a ten-foot pool of water; thence to the ancient mica mines of Bakersville, and Burnsville, where Wildberger was stricken with typhoid and with Straight was taken to a railroad some 75 miles away, while the writer and Barclay crossed Roan Mountain, stopped on the Tow River, spent our last quarter for supper, lodging and breakfast, and made the distance (40 miles) to Johnson City on one dime, which the lady who gave us dinner refused to take. We reached the railroad at Johnson City, where our finances were replenished, and home next day after a tramp of some 400 miles with much profit and still greater pleasure.

MALCOLM H. CRUMP
BOWLING GREEN, KENTUCKY

SCIENTIFIC EVENTS

ST. GEORGE EXPEDITION TO THE PACIFIC

THE St. George Expedition to the Pacific reached the Isthmus of Panama on June 9, 1924, and from there visited Isla del Rey in the Pearl Islands, Gorgona off the Colombian coast, some of the islands of the Galapagos group, Cocos (one day only, as weather conditions were unfavorable for a longer stay), Coiba Island and Taboga Island.

Zoological collections were made at all these islands. Mammals and reptiles were taken by Mr. P. H. Johnson, and his collection includes a white-faced black monkey, a three-toed sloth, three species of bat and a good series of rats from Gorgona; a howling monkey from Coiba Island and a series of rats exhibiting a wide range of variation from the Galapagos Islands.

Over three hundred specimens of birds have been obtained by Lieutenant-Colonel H. J. Kelsall. This is far less than he had hoped for, but various unforeseen and unavoidable difficulties in connection with collecting were experienced. Four species only of land birds were obtained on Gorgona during eight days' careful collecting; and, of these, two only were at all common. The forest, which is fairly dense, was penetrated to the summit of the highest peak, about 1,200 feet high, and up the courses of several of the very numerous streams.

Miss Cheesman has devoted her attention principally to those orders of insects which are most wanted by the British Museum as they are often not obtained by the ordinary collector. Lepidoptera and coleoptera have been collected by Mr. C. L. Collenette with the assistance of Miss C. Longfield. It is probable that some of the species of insects will prove to be new, but it is impossible to ascertain this until the collections have been worked out.

Dr. C. Crossland has collected the marine worms, Nudibranchs, Polyzoa, Hydroids and Algae. It is expected that these will afford most useful data for the settlement of synonomy and consequently for better knowledge of geographical distribution. At least five Atlantic species of polychaetes have been found in the Panama region, indicating that an appreciable number will be found common to both the Atlantic and the Pacific when the collections shall have been systematically examined.

Mr. J. Hornell has collected marine and terrestrial mollusca, while Mr. L. J. Chubb has amassed an extensive series of rock specimens and notes from the various islands.

The outstanding event of the expedition, so far as can be judged at present, has been the discovery of figures graven upon large boulders now lying between high and low water marks on the eastern shore of Gorgona. The first of these was found by L. Cullingford, one of the crew, and brought to the notice of Mr. J. Hornell, the ethnologist, who subsequently discovered a good many others. The most important were two series of archaic figures, among which are to be distinguished what appear to be rude representations of sun-gods and a stepped pyramid, together with figures of monkeys, birds and other animals. Besides these there are two comparatively modern sculptured portraits; one perhaps of Inca age, the other probably referable to the buccaneering days of the eighteenth century. Some stone weapons and implements were also found, associated with potsherds of considerable interest. Photographs and squeezes of the sculptures were taken and have been sent to the British Museum.

It was unfortunate that our botanist, Mr. L. A. M. Riley, was forced on account of serious ill-health to return to England from Panama; botanical specimens were, however, collected at most places by the other scientists and sent to Kew.

We understand from a cable recently received that much interest has been aroused by the archeological discoveries, while the authorities at Kew attribute considerable importance to the collection of flowering plants made at Gorgona, in consequence of which the scientific staff have decided to pay a second visit to this interesting island in order to search it thoroughly for further archeological remains, and to make the botanical material as complete as possible. It is intended to explore the western side and southern end of the island, which it was not found possible to do during our first visit.

An interesting series of kinema and still photo-

graphs of bird and other animal life was obtained at the Galapagos Islands.

James Hornell,
Ethnologist and scientific director,
Cyril Crossland,
Marine biologist,
G. H. Johnson,
General biologist,
H. J. Kelsall, Lt.-Col.,
Ornithologist,
L. C. Cheesman,
Entomologist,
C. L. Collenette,
Assistant entomologist,
L. J. Chubb,
Geologist.

S. Y. "St. George,"
Balboa, September 27, 1924

BIOLOGIA GENERALIS

It is the purpose of this note to call attention to a new biological journal, available to American workers, the first number of which will appear shortly. This journal, *Biologia Generalis*, is truly international in character, accepting contributions in either English, French, German, Italian or Russian, according to the author's wish. The responsible editorship rests in the following three persons: Professor Vladislav Ruzicka, Institute of General Biology, Prague, Czecho-Slovakia; Professor Leopold Löhner, Institute of Physiology, Graz, Austria; and the writer of this note. Cooperating with these three are the following coeditors:

J. Athanasiu, Bucharest; E. Bataillon, Montpellier; D. Calugareanu, Cluj; C. M. Child, Chicago; F. A. E. Crew, Edinburgh; Sp. Dontas, Athens; G. H. J. Ekman, Helsingfors; E. Giglio-Tos, Cagliari; E. Gley, Paris; E. Godlewski, Jr., Cracow; J. A. Bierens de Haan, Groningen; R. G. Harrison, New Haven, Conn.; L. J. Henderson, Cambridge, Mass.; E. Herouard, Paris; J. S. Huxley, Oxford; N. K. Kolzow, Moscow; S. Kopec, Pulawy; J. Krizenecky, Brno; W. W. Lepeschkin, Prague; A. Lipschütz, Dorpat; S. J. Metalnikoff, Paris; B. Nemec, Prague; Ch. Ogawa, Kyoto; O. Polimanti, Perugia; H. Poll, Berlin; M. Popoff, Sofia; O. Porsch, Vienna; H. Przibram, Vienna; J. A. M. Runström, Stockholm; J. Schaxel, Jena; Ch. R. Stockard, New York; S. Tschulok, Zurich; J. Wilczynski, Wilno; B. Zarnik, Zagreb; M. Zawadowski, Moscow. The late Sir William Bayliss was a coeditor up to the time of his lamented death.

The responsible publisher is Emil Haim and Company (Vienna and Bratislava, C. S. R.), and the American publisher's agent, The Johns Hopkins Press. The journal will appear in numbers of five signatures each, six numbers forming a volume. The numbers will, in general, appear at as frequent intervals as the accumulation of material for publication demands.

That there is room for a new first-class journal of general biology, offering opportunity for the prompt publication of original investigations in this field would seem to admit of no argument. There is an ever-increasing pressure of good work on the available avenues of publication. Such a journal will, in a sense, supplement the several well-established series of biological monographs which exist, among which may be mentioned the well-known "Vorträge und Aufsätze über Entwicklungsmechanik," edited by Roux; the equally well-known and established American series of "Monographs on experimental biology," founded by Loeb, Morgan and Osterhout; the "Bibliothèque de la biologie générale" of M. Caullery; and the "Abhandlungen zur theoretischen Biologie und Arbeiten auf dem Gebiete der experimentellen Biologie" of Schaxel. At the present time the current literature of general biology, because of its manifold and close points of contact with the various organic and inorganic sciences, is scattered in a great number of different journals. Out of these considerations arose the determination to establish a journal devoting the major portion of its space to the publication of original investigations in the field, and at the same time impartially reporting in short abstracts the results of work published elsewhere.

Biologia Generalis will be open to original articles dealing with the three main divisions of general biology, namely, general morphology, physiology and ecology, without prejudice to the different methods or direction of research except the purely metaphysical ones. The editorship hopes that all workers interested in general biology and kindred branches of science will make full use of this journal.

Manuscripts and inquiries relating to editorial matters originating in America should be sent to Raymond Pearl, Department of Biometry and Vital Statistics, The Johns Hopkins University, Baltimore, Maryland. American inquiries relating to subscription and other business matters should be addressed to The Johns Hopkins Press, Homewood, Baltimore, Maryland.

Raymond Pearl

THE SECOND AMERICAN ASSOCIATION PRIZE

At the regular fall meeting of the executive committee of the American Association for the Advancement of Science it was decided that the arrangements for awarding the second American Association prize are to be similar to the arrangements by which the first prize was awarded last year at Cincinnati.

As in the case of the first prize, the amount of the second prize is to be one thousand dollars, which is to be awarded to the author of a noteworthy contribution to science presented at the approaching fifth Washington meeting of the American Association and associated organizations. The prize is not competitive in the usual sense and no formal entry of papers will occur. Only papers that appear on the program of the Washington meeting will be considered. The programs of all the scientific societies meeting with the association at Washington will be considered, as well as those of the association itself. Since it is the aim of the association to further the advancement of American science and education in all feasible ways, it will not be necessary that the chosen contribution be by a member of the association.

The award will be made at the close of the meeting and it will probably be announced late on January 3, 1925, in time for the Sunday morning papers of January 4. It will be made by a committee of scientists to be named by the council early in the meetings. The committee on award will receive from the secretaries of the sections and societies meeting with the association at Washington suggestions of noteworthy contributions in the various fields of science.

The inauguration of the American Association prize, which occurred last year at the seventy-fifth anniversary, at Cincinnati, aroused interest to a marked degree. The recipient of the first prize was Professor L. E. Dickson, of the University of Chicago, for a great contribution to mathematical science. It is expected that the interest in the second prize to be manifested by those in attendance at Washington and by the intellectual public as well, will even surpass the interest shown last year. The American Association is particularly gratified to be able to continue awarding these thousand-dollar prizes. Through the great generosity and helpful spirit of one of the members of the association, arrangements have been made by which five annual prizes are now provided for, in addition to the prize awarded last year. It is planned that the prize will be awarded at each of the four annual meetings following the fifth Washington meeting. The third prize will be awarded at the Kansas City meeting, at the close of the year 1925; the fourth prize at the fifth Philadelphia meeting, at the close of 1926; the fifth prize at the meeting to occur at the close of 1927 (place of meeting as yet undecided); and the sixth prize at the fifth New York meeting, at the close of 1928.

BURTON E. LIVINGSTON,
Permanent Secrttary

DINNER OF THE NEW YORK ALUMNI OF SIGMA XI

A DINNER for the alumni of Sigma Xi, of which there are about one thousand members in New York City, has been arranged to take place on Monday evening, November 17, at 7:00 P. M., at the Fraternity Club, 245 Madison Ave., New York City.

The "New battle front of civilization" will be the topic of the principal address by Dr. Vernon Kellogg, secretary of the National Research Council and a member of the executive committee of Sigma Xi. Supplementary remarks on the same topic will be made by Dr. E. L. Thorndike, professor of psychology at Columbia; Dr. Edwin E. Slosson, director of Science Service; F. B. Jewett, vice-president in charge of research of the Western Electric Company; Dr. Francis Carter Wood, director of cancer research, Crocker Laboratory, and Dr. Michael Pupin, professor of electromechanics at Columbia University. President F. K. Richtmyer, of Cornell University, will be present to explain the broad program upon which Sigma Xi is embarking. Secretary Edward Ellery, of Union College, will act as toastmaster. Invitation cards may be obtained from C. E. Davies, chairman.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE WILLIS RITCHEY, of the Solar Observatory, California, has been awarded the Janssen gold medal by the Paris Academy of Sciences for his work in connection with the construction of the reflecting telescope.

DR. JOHN M. T. FINNEY, professor of clinical surgery at The Johns Hopkins University, has been elected foreign corresponding member of the Royal Academy of Medicine of Belgium.

THE French Government has conferred the decoration of chevalier de la Légion d'Honneur upon Dr. W. H. Hobbs, professor of geology; Dr. F. G. Novy, professor of bacteriology, and Dr. H. P. Thieme, professor of Romance languages, all of the University of Michigan.

A NEW portrait of President E. A. Birge, of the University of Wisconsin, by Merton Grenhagen, of Milwaukee, has been completed and will soon be hung in the Regents room of the university. A portrait of of Professor R. L. Jones, of the College of Agriculture, has also just been completed by Mr. Grenhagen to be hung in agricultural hall.

THE University of Pennsylvania has announced that a further gift had been made by John C. Bell for the erection of statues in honor of two former provosts of the university, Dr. Charles C. Harrison and Dr. Edgar Fahs Smith. It is expected that the two statues will be completed in time for presentation to the university next commencement day. Dr. R. Tait McKenzie, director of physical education, is to be the

sculptor for the statue of Dr. Smith, while Lynn Jenkins, the English sculptor, is creating that of Dr. Harrison.

DR. P. B. BERLOTY, director of the Ksara Observatory in Syria, has been elected a corresponding member of the French Academy of Sciences in the section of geography and navigation, in the place of P. Colin.

THE Budapest Veterinary Academy has conferred the degree of doctor of veterinary sciences, *honoris causa*, on Sir John McFadyean, principal of the Royal Veterinary College, England.

THE Beal medal of the American Gas Association, awarded annually for the best technical paper presented at previous meetings of the association, has been awarded to A. W. Warner, of Chester, Pa., for his paper entitled "The study of physical laws governing carbonization of coal."

DR. GEORGE C. WHIPPLE, Gordon McKay professor of sanitary engineering at Harvard University, has been commissioned in the Reserve of the United States Public Health Service as directing sanitary engineer with the grade of assistant surgeon general.

AT the Storrs Agricultural Experiment Station Dr. Walter Landauer, formerly of the Zoological Institute, Heidelberg University, has joined the staff as fellow in genetics (poultry investigations). Miss Margaret Schneider has been granted leave of absence for the first semester and is studying in the department of zoology, Columbia University.

W. TAYLOR THOM, JR., has been appointed geologist in charge of the newly formed section of geology of fuels in the Division of Geology, United States Geological Survey.

ALDEN H. MOODY, recently with the Union Carbide and Carbon Research Laboratories, has joined the chemical staff of the Brooklyn Polytechnic Institute.

J. J. MARRIS, nitrogen chemist of the Mississippi Department of Agriculture, has been appointed to the staff of Law & Co., consulting and analytical chemists at their Wilmington, N. C., laboratories.

NEIL HOTCHKISS, a graduate of Syracuse University, has been appointed assistant in agrostology (junior botanist) in the United States Bureau of Plant Industry.

PROFESSOR S. LEFSCHETZ, of the University of Kansas, has been appointed visiting professor of mathematics at Princeton University for the year 1924–25.

DR. HENRY MCE. KNOWER is spending this winter as visiting professor of anatomy, in charge of the courses in histology and neurology at the medical college of the University of Georgia, Augusta.

DR. C. B. HUTCHINSON, director of the branch of the College of Agriculture of the University of California at Davis, has left for Europe to join Dean A. R. Mann, of the College of Agriculture at Cornell University, at the International Institute of Agriculture in Rome. They will study conditions of agriculture and engage in the promotion of agricultural research and instruction and do not expect to return for two years.

PROFESSOR GEORGE G. MACCURDY, of the Peabody Museum, Yale University, recently returned from France, bringing over relics of men and animals of the pre-historic age. Since last spring he has been excavating at Sergeac, near Bordeaux, and at Solutre, near Lyons.

DR. HAVEN EMERSON, professor of public health administration in the Columbia University College of Physicians and Surgeons, New York, will make a survey of health conditions in Cincinnati beginning about November 10.

MR. AND MRS. VISSER, whose first expedition to the Karakorum Mountains, a spur of the Himalayas, in 1922 met with insurmountable obstacles, intend to start a second expedition in 1925.

MRS. AGNES CHASE, assistant agrostologist of the United States Bureau of Plant Industry, sailed for Brazil on October 18, where she will remain about six months studying and collecting grasses.

DR. HERBERT E. IVES lectured before the Western Society of Engineers, in Chicago, on October 20, on "The transmission of photographs over telephone lines," describing the system recently developed by engineers of the Bell system.

DR. C. B. BAZZONI, professor of experimental physics in the University of Pennsylvania, delivered a lecture on "The atomic nucleus" before the Swarthmore chapter of Sigma Xi on October 28.

DR. THORWALD MADSEN, director of the Serological Institute, Copenhagen, Denmark, delivered the Wesley M. Carpenter lecture, of the New York Academy of Medicine, on October 16.

DR. OTTO OLDENBERG, of the University of Göttingen, Germany, gave a lecture on October 29 at the Massachusetts Institute of Technology entitled "Phosphorescence and fluorescence phenomena."

PROFESSOR E. C. C. BALY, of the University of Liverpool, addressed the New York section of the American Chemical Society on November 3 on the subject "Photosynthesis."

DR. H. J. PAGE, of Harpenden, England, gave a lecture at Cornell University, October 1, on "The work of the Rothamsted Experimental Station."

DR. CHARLES EDWIN PERKINS, clinical professor of otology in Bellevue Hospital Medical College, died on October 23, at the age of fifty-seven years.

DR. JOHN VAN DENBURGH, physician and head of the department of herpetology of the California Academy of Sciences, has died by suicide.

EDWARD LOTHROP RAND, corresponding secretary of the New England Botanical Club from 1895 until 1921, died at his home in Cambridge, Mass., October 9, 1924. A correspondent writes: Mr. Rand was born in Dedham, Mass., on August 22, 1859. He was graduated from Harvard College in 1881 and from the Harvard Law School in 1884. He practiced law in Boston for many years, but devoted much attention to botany. In collaboration with the late John H. Redfield, of the Philadelphia Academy of Natural Sciences, he prepared and in 1894 published a detailed Flora of Mount Desert Island, Maine, which at the time was one of the most complete works of its nature that had appeared in any part of America. He was among the founders of the New England Botanical Club and was a member of the publication committee of its journal, *Rhodora,* from 1898 until his death. He gave to the club in 1914 his extensive herbarium of Mount Desert plants.

THE president-elect of Mexico, General Calles, and a group of Mexican physicians and public men visited the Pasteur Institute, Paris, on Wednesday, October 8, 1924. They were received by Dr. Roux, the director, and members of the staff of the institute. In a few words of welcome Dr. Roux expressed his pleasure at the interest of the president in medical research and measures to promote public health. General Calles was invited to sign the Golden Book of the institute and, as a souvenir of the occasion, was presented with a portrait of Pasteur. The party was then shown the apartments of Pasteur and the permanent exhibit of his apparatus and mementos, and afterwards the various laboratories of the institute and the magnificent tomb of Pasteur.

THE joint program of Section G, of the American Association for the Advancement of Science with the Botanical Society of America, the American Phytopathological Society and other botanical organizations, will be held on Tuesday afternoon, December 30. This program, which occupies the afternoon of the first full day of the Washington meeting, will be opened by an address on "The origin of the cycads," by the retiring vice-president of Section G, Dr. C. J. Chamberlain. This address will be illustrated. The following invitation papers will then be presented: "Root studies," by Dr. J. E. Weaver, of the University of Nebraska. "Soil nutrients," by Dr. E. J. Kraus, of the University of Wisconsin. "Mosaic and related diseases," by Dr. L. O. Kunkel, of the Thompson Institute for Plant Research. Correspondence should be addressed to the secretary, Dr. Robert B. Wylie.

THE American Society of Naturalists will meet in Washington, D. C., on Thursday, January 1, 1925. Headquarters of the society will be the Hotel Raleigh, Pennsylvania Avenue and 12th Street, N. W. The rates are $3.00 to $10.00. The morning program will be devoted to an address by Dr. John C. Merriam. In the afternoon a symposium on growth will be participated in by Drs. Alexis Carrel, Charles R. Stockard, Lafayette B. Mendel and D. T. MacDougal. The evening will be occupied with the annual dinner and the address of the president, Professor W. H. Howell. No preliminary notice of the meeting will be mailed to members this year.

THE fifteenth annual meeting of the American Association for the Advancement of Agricultural Teaching will be held at the Willard Hotel in Washington on November 11.

THE annual meeting of the American Society of Agronomy will be held in Washington, D. C., on November 10 and 11, under the presidency of M. F. Miller. There will be symposia on the following subjects: Economic relationships of agronomy, agronomic observations in foreign lands, soil colloids, nitrogen fixation, the legume problem and plant physiology and agronomic science.

AT the Madrid meeting of the International Geodetic and Geophysical Union, held from October 1 to 10, it was decided to hold the next congress in Prague in 1927.

AT the regular meeting of the New Jersey Chemical Society held in Newark on October 14, David Wesson, consulting chemist, Southern Cotton Oil Co., delivered his presidential address on "Some chemical problems and responsibilities." Dr. Jerome Alexander, consulting chemist, New York City, gave an address entitled "Bridging the gap between masses and molecules."

AT a symposium at the Pittsburgh, Pa., station of the U. S. Bureau of Mines, dealing with the subject of the importance of chemistry in food product development, October 16, the following speakers gave addresses: John C. Fetterman, director, National Certification Laboratory, "The chemist in the dairy industry"; H. N. Riles, director of research, H. J. Heinz Co., "The chemist in the packed food industry"; T. B. Downey, senior industrial fellow, Mellon Institute, "The chemist in the edible gelatin industry,"

and E. S. Stateler, technologist, Hershey Brothers, "The chemist in the confectionery industry."

THE will of the late Elizabeth Blee Frasch directs that her estate of over $5,000,000 be held in trust by the United States Trust Company and the income be used for "research in the field of agricultural chemistry, with the hope of attaining results which shall be of practical benefit to the agricultural development of the United States." It is provided that the trustee after advising with the American Chemical Company select one or more incorporated institutions in the United States and pay the income to them upon the condition that they agree that the money will be devoted to research in agricultural chemistry.

THE will of the late Henry R. Towne, engineer and head of the Yale and Towne Manufacturing Company, disposes of an estate estimated at several millions and gives the bulk of it as a residuary bequest after the death of his son, to establish museums of peaceful arts, or industrial museums for the people of the City of New York. He gave $50,000 for "a campaign of education, news and publicity designed to bring prominently to public notice essential facts concerning the great industrial museums of Europe." If it is deemed inexpedient by the executors and trustees, by unanimous judgment, to expend funds for peace museums, the residuary estate is to be divided into two equal parts for the benefit of the Metropolitan Museum of Art and the American Museum of Natural History. Other bequests include $10,000 for the Franklin Institute of Philadelphia to be held in trust as a fund in memory of Mr. Towne's father, the late John Henry Towne, who was actively connected with the institute; $50,000 fund, to be known as the "Henry R. Towne Engineering Fund," to the United Engineering Society of New York, and $10,000 to New York University for its endowment fund.

THE residue of the estate of the late Mrs. Gordon Dexter, of Boston, estimated at several hundred thousand dollars, is left to Harvard University for research in bacteriology and for the purchase of books for the library.

NEW YORK may acquire a community forest, or plant one, by recommendation of Professor Hugh Findlay, of Columbia University, who is directing work along the lines of reforestation and tree conservation for university extension students. Central Park and the New York Botanical Gardens will be used by his students as laboratories in experimental work. A special investigation will be made of the importance of birds to forest and home trees, and of the use of trees in industry.

UNIVERSITY AND EDUCATIONAL NOTES

THE University of Chicago has set aside a tract of nine acres, the two blocks west of Ellis Avenue facing the midway, to be devoted wholly to the new medical school. The buildings now on this tract will be removed in time, and the university will immediately spend $4,000,000 for hospitals, laboratories and teaching quarters, and eventually not less than $3,000,000 more. To endow the work to be housed in these buildings will call for $5,000,000 in the near future.

THE Worcester Polytechnic Institute is planning a new mechanical engineering building to cost approximately $350,000.

YALE UNIVERSITY and the New York Nursery and Child's Hospital are named residuary legatees in the will of the late Mrs. Lucie A. Bliss. The fund for Yale is to be used for increases in salaries of professors.

PROFESSOR JOHN BARLOW, for 21 years head of the department of zoology in Rhode Island State College, has been appointed dean of the general science course in that college.

FOLLOWING the recent resignation of Dr. Henry Page, a committee has been appointed by the board of directors of the University of Cincinnati to administer the work of the college of medicine. The members are: Dr. Arthur C. Bachmeyer, superintendent, Cincinnati General Hospital; Dr. Alfred Friedlander and Dr. Nathan C. Foot. Dr. Bachmeyer, as chairman of the committee, will be the acting dean.

DR. EDWIN G. BORING, associate professor of psychology at Harvard University, has been appointed director of the psychological laboratory.

AT Harvard University, Dr. Robert B. Osgood has been appointed John B. and Buckminster Brown professor of orthopedic surgery to succeed the late Professor Robert W. Lovett and Dr. William L. Moss has been appointed assistant professor of bacteriology.

E. M. SPIEKER has been granted leave of absence from the United States Geological Survey to give a course of instruction in geology at Ohio State University.

H. W. WRIGHT has accepted a position as professor and head of the department of chemistry in Union College, Kentucky.

DR. E. FITERRE, who has been studying in Paris on the Albarran fellowship for two years, has been appointed associate professor of physiology at the University of Havana.

DR. CARL F. SCHMIDT has been appointed assistant professor of pharmacology at the University of Pennsylvania.

HAROLD A. LARRABEE, who has just returned from a year of study in Europe on a fellowship from Harvard University, has been appointed assistant professor of psychology in the University of Vermont.

PAUL E. EATON, of Ithaca, N. Y., has been appointed assistant professor of mechanical engineering at Lafayette College.

APPOINTMENTS to the staff of the University of Pennsylvania School of Medicine have been made as follows: Dr. George Fetterolf, professor of otolaryngology, succeeding Dr. Burton Alexander Randall, retired; Dr. J. Claxton Gittings, professor of pediatrics, succeeding Dr. J. P. Crozer Griffiths, also retired, and Dr. William C. Stadie, assistant professor of research medicine.

DISCUSSION AND CORRESPONDENCE

THE TEMPERATURE OF MARS

IN a note published in the issue of SCIENCE of October 24, *Science Service* anonunces the results of the measurements on Mars, taken at Mt. Wilson. These measurements indicate that the noonday temperature on the Martian equator is about 10° C. or 42° F. Then, referring to the results obtained at the Lowell Observatory, Flagstaff, Arizona, previously announced in SCIENCE of September 26, in which the temperature of Mars under a noonday sun was found found to be *up to* 20° C. (*sic*) the comment is made that these two "observations are not in complete agreement."

In view of the fact that this statement has already caused doubts in the minds of some of those uninitiated in the intricacies of the problem a few supplementary remarks are in order.

When we consider 10° C. with 20° C. then it is true that there is a difference of 10° C.—and this on a planet 34 millions of miles away. But it is of interest to note that, if two laboratories undertook to measure the radiation from some close-by terrestrial source, at 15° C., the chances are that their temperature estimates would differ by 10°—and they would not be harrassed by the incompletely solved question of the spectral transmission of a dense atmosphere like that of the Earth, not to mention the everchanging clouds on Mars. But 10° C. difference has no significance in comparison with what has been accomplished as a whole. For instead of disagreement it means agreement. It means that for the first time in history two observatories, working independently, have arrived at the conclusion, radiometrically, that the noonday temperature of the surface of Mars is considerably above 0° C., which is the view held by astronomers who, for years, have been making the observations visually.

No wonder I am receiving protests from some who, relying upon calculations which indicate maximum temperatures far below 0° C., say "You are wrong." Quite naturally, it is comforting to me to see the Flagstaff work of 1922 (from which temperature estimates of 10° to 20° C. were obtained) and of the present opposition of Mars, confirmed by the powerful instruments at Mt. Wilson.

On the other hand, the calculators of planetary temperatures can take comfort in the remark, made by the late Professor Edward Morley, that the mathematical mill is no different from any other—you grind out what you put in, nothing more. When we have sufficient and accurate data, upon which to base our assumptions, the calculated planetary temperatures will no doubt be in agreement with the observations.

W. W. COBLENTZ

TRENDS OF MODERN GEOGRAPHY

IN "Trends of modern geography" (SCIENCE, October 24, 1924, pp. 374–376), Dr. Clarence F. Jones has presented the viewpoint of a number of human ecologists, here and abroad, who would narrow the field of geography by relegating physical geography to another sphere. Nevertheless, every geographer, as part of his geographical training, must study the sciences of the land, the water and the air as the fundamental bases of modern geography; for no indifferently understood foundation can uphold the vast superstructure of human relationships to natural environment. No student at Clark, for example, is given a graduate degree in geography unless he can show a reasonable understanding of at least the following phases of geography: physiography, meteorology and climatology, soils, native vegetation, agricultural geography and land utilization, economic geography and anthropogeography. Should not then human ecology be recognized as but the crowning phase, rather than pressed on us as constituting the whole of geography? Can there be geography without the "geo-"?

CHARLES F. BROOKS
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NOTE REGARDING THE TREATMENT OF EAR CANKER IN RABBITS

As stated by David Marine, of Montefiore Hospital, New York, in SCIENCE of August 15, 1924, Vol. LX, p. 158, ear canker (*Psorocoptes cuniculi*) is one of the most troublesome diseases that has to be contended with in the rearing and care of rabbits. We have to be constantly on the alert to discover and treat it in the animal room of the Stanford Medical School. Our method, while different from the one recommended by Mr. Marine, is just as effective as the kerosene

spray which he recommends in the article referred to above. For many years we have used a 3 per cent. carbolized sweet oil. This should be sprayed or poured into the ear in sufficient amount to penetrate the paper-like structure which the mites construct. Any oil or member of the petroleum derivatives is instantly fatal to all insects and mites. Kerosene has the advantage of being more rapidly diffusible and penetrating than sweet oil; it is also more or less irritating and no doubt produces a smarting when applied to the sensitive inner surface of the ear. On the other hand, sweet oil acts less rapidly as regards penetration, but it is soothing and softens the scales, hastens desquamation of the dried epithelium and favors rapid healing; the phenol relieves the itching and antagonizes infection. The purpose of this note is not to criticize but simply to mention an additional therapeutic remedy for the disease.

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A METHOD FOR FACILITATING SCIENTIFIC READING

MUCH time is needlessly consumed by scientific workers in trying to locate in a journal or book some data they vaguely recall having read. I am not unusually impetuous, but it must be confessed that this particular loss of time has been extremely aggravating on occasions. For a period I projected, as psychologists now call it, my memory failings into the construction of the journals. I have said many bad things about editors for not furnishing a complete functional index with each volume, an index that would tell the research worker on just what pages lactic acid is mentioned or just where in the six hundred odd pages there are charts showing the development of fatigue effects in muscular work.

Perhaps I have wanted too much, but one must be consistent and maintain that there is at least some justification for his outbursts of criticism. At any rate the alphabetical list of authors or titles furnished annually by the journals does not provide fullest aid in locating missing tables and figures.

Criticism does not go very far. So it became necessary to make up for the editors' continued neglect. After trying several schemes I have decided that the one I shall describe leaves least to be desired. This is the adoption of visual tabs such as are used in office filing systems.

Whenever I chance across a reference to, or data on ventilation I now paste a strip of light lavendar paper about 5 mm by 20 mm on the upper edge of the page—provided, of course, it is my book or journal. In case it is a table of data that is being marked I write a "T" on the visible portion of the colored tab, which is about 5 mm square. If the tab happens to be indicating a chart the letter "C" is marked on the visible part, or "R" in case it marks a reference I am certain is not in my library or I do not have abstracted.

The complexity of such a functional index is limited only by the ingenuity and color discrimination of the user. At present I am using 26 colors without confusion, and with much saving of time and patience. Whenever I want research material for a class lecture or an article, for instance, on individual differences all I have to do is to thumb through the tops of my library and browse through the pages indicated by the blue tabs. If it is sex differences I am most interested in for the moment I open only the pages marked by the blue tabs with "sex" printed (by hand) on them; if it is racial differences only the blue tabs sub-divided by "race" are used as a guide in the reading. In an evening a hundred tables of data or charts or sagacious remarks can be located with a rapidity that brings great comfort and confidence.

Reprints can profitably be indexed in a similar fashion when they are read. Filing of these leaflets is usually accomplished in many modes which vary with the seasons. When a visual tab system is used to guide reference reading reprints may be filed in the easiest way to preserve their shape. The most economical way to do this is to punch two holes near the stapling and fasten two dozen or so together with large brass staples into a compact booklet. Related subjects can be stapled together, and those reprints that it is difficult to tell just where they belong in any rational classification—they are many—can be placed wherever the shelves need filling since the visual tabs will make the contents readily available on a moment's examination.

Colored tabs can be made from kindergarten paper which is easily obtained; the heavier the stock the better. These can be cut into strips 5 mm wide. Then these long strips can be cut *part way* across every two centimeters of their length, leaving about 1 mm of the stock holding the tabs in each strip together.

The best way to keep order in a hundred or more such strips has seemed to be to paste them on a piece of cardboard about 6 cm wide and as long as the number of colors (not strips) being used and anticipated indicate. The strips should be "tacked" on with a *small* area of paste along the long edge of the cardboard, so that the long axis of the colored strip is at right angles to the long axis of the cardboard. Several strips of the same color may be placed one

above the other, and as soon as the supply of tabs in any color is used up another set of strips may be prepared and pasted on this card.

The strips may be arranged according to the spectrum or by the alphabetical order of topics they are to indicate. I have found the latter more convenient, especially with the subject each color indicates written opposite the strips of that color on the cardboard holder. I have two such holders in use in daily reading, one at the laboratory and one at home. The preparation of additional strips furnishes constructive amusement to children who find kindergarten entertainments to their liking.

I have still to be convinced that a functional index, with almost the completeness of a dictionary, should not be demanded by the readers of scientific journals. In the meantime it is up to the readers to convince the editors of a serious omission in their commonly gratuitous undertaking.

DONALD A. LAIRD
COLGATE UNIVERSITY

A PROPOSED BIOGRAPHICAL ENTOMOLOGICAL DICTIONARY

AMERICAN entomologists and arachnologists should be much interested in the project of Professor Embrik Strand to publish a Biographical Entomological Dictionary containing the autobiographies of all entomologists and arachnologists who have done scientific work as authors or as collectors in all parts of the world.

This project has been explained in *Entomological News*, May, 1924, page 178, also May, 1924, pages 227–9, and in *The Entomologist* for March, 1924, page 68. However, the response from American entomologists has not been very great. The project has several auspicious features that should warrant wholehearted and prompt support: (1) There is no question about the publication of data; (2) the editor appreciates the desirability of individuality in the form of the biographies; (3) it is not necessary to be saving of space, since the editor suggests that all the main points in the life of the individual, even though they may have nothing to do with the professional career, should be included; for example, work in other biological fields than entomology or arachnology.

All persons who have done work with insects or spiders are urged to send an autobiography to Professor Strand at the earliest opportunity. Professor Strand's address is: Professor Embrik Strand, Director of the Systematic Zoological Institute, Universität, Kronvalda bulvars 9, Riga, Latvia.

To facilitate the assembling of the autobiographies of Americans, it is suggested that they may be sent to Dr. H. P. K. Agersborg, Department of Biology, The James Millikin University, Decatur, Illinois, or to Professor C. L. Metcalf, 201 Natural History Building, Urbana, Illinois, who will be glad to forward them by registered mail to Professor Strand.

H. P. K. AGERSBORG
C. L. METCALF

SPECIAL ARTICLES

CAN THE HYDROGEN ION CONCENTRATION OF LIVING PROTOPLASM BE DETERMINED?

THE various determinations that have been made of H-ion concentration in organisms are applicable in the case of plants only to the cell sap, and in the case of animals usually to no more than body fluids bathing the exterior of the cells. To assume that the results correspond to the cH of the protoplasm in contact with these inanimate fluids would be unjustifiable, as the following experiments will demonstrate. The subject of study is *Pelomyxa palustris*, a multinucleate Amoeba which frequently attains the giant size of 3 mm or more in diameter. Its markedly vesicular or foam structure renders this organism peculiarly suitable for colorimetric tests of cH; for, since it is desirable that the indicator should be as uniformly distributed as possible, and since it is impossible, as far as I am aware, to impart a visible coloration to living protoplasm itself, the nearest approach to ideal conditions is afforded by such an intimate foamy admixture of protoplasm and vacuolar fluid as *Pelomyxa* presents. The average diameter of the vacuolar vesicles is one third to one half that of the nuclei, but larger and smaller ones also occur. Neutral red was the indicator used. It is absorbed readily from dilute solution and forms in the vesicles a much more concentrated solution than in the external liquid. Granules in the protoplasm also stain deeply, but their color is little affected by the cH of any medium in which they may be placed and so is of no use as an indicator.

The tint of the neutral red in the great majority of the vesicles is practically uniform and corresponds sometimes to a neutral and sometimes to a very slightly acid medium. It is more acid than the water outside—a relation which seems to hold whenever the cH of cell vacuoles is compared with that of the bathing fluid. Comparing therefore the three media, cell sap, protoplasm and external liquid, we see that the neutral red has a different concentration in all three media and the H-ions in at least two of them. Why, then, should we assume that their concentration in the protoplasm agrees with that of the internal rather than the external liquid or indeed with either?

There is, however, more convincing evidence that the protoplasm is deliminated sharply as regards

acidity from at least some of its vacuoles, for certain of these may assume a cH widely differing from that of the rest. Parenthetically it may be remarked that *Pelomyxa* is a gross feeder and is usually crammed with algae, diatoms, small animals, sand and débris. These lie in the vacuoles and the living ingesta are for the most part apparently uninjured by their situation, proving the innocuous character of the contents of the ordinary vacuoles. An occasional vesicle, however, may assume digestive functions. Usually a few of these are to be seen in any large *Pelomyxa*. I have watched the acidity increase in an ordinary vacuole until the neutral red assumed a deep purple or bluish tint. The contained alga, green and apparently healthy to begin with, having its own vacuole stained orange by the dye, lost the orange hue of its sap, lost its green color and became ultimately disorganized. At a later stage one finds in such vacuoles only a collection of strongly stained granules in rapid Brownian movement. The granules diminish in number, apparently passing into the protoplasm, and the hue of the indicator returns to normal. Very occasionally an alkaline vesicle may be observed—deep yellow with neutral red—containing a few granules (still of the same deep red color as in an acid vacuole). Since the ordinary vacuoles do not contain granules this may represent a subsequent stage in the history of a digestive vacuole.

These phenomena illustrate very well how, even in a liquid circulating mass of protoplasm, chemical substances and chemical operations may be localized within narrow limits. More particularly they demonstrate that the H-ion concentration of a vacuole can be no criterion of that of the protoplasm that surrounds it—may indeed be such as applied externally would be lethal.

Similarly, the absence of any distinct local variations in cH in the vesicles of *Pelomyxa* during the cycle of physical changes that attends its amoeboid movement does not prove that no such variations of cH take place in the protoplasm.

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THE TOTAL IONIZATION PRODUCED IN AIR BY ELECTRONS OF VARIOUS ENERGIES

RECENT experiments on the total ionization produced by slow electrons in air have yielded results in agreement with the Bohr[1] theory of ionization in the region of the faster, low-speed electrons for which exact ionization experiments had not previously been performed. Since the experiments with very slow electrons have indicated an increase in the ionizing efficiency of electrons with increasing speed and experiments with hard cathode-rays and β-rays have shown the same quantity to decrease with increasing velocities it appeared that a maximum value must lie somewhere in the intervening range.

Previous experiments with low-speed particles have been limited in their application due to the fact that at the pressures used the electrons with the greater energies in this range hit the sides of the ionization chamber before their energy had been exhausted. In these experiments an ionization chamber of hemispherical shape was sealed off from the tube where the electrons were emitted from a hot tungsten filament, except for a small capillary hole in the anode, one end of which was 2 mm from the filament and the other end at the geometric center of the ionization chamber. By running a diffusion pump system during the experiment, and adjusting an artificial leak into the ionization chamber the air pressure in the filament tube was kept between 0.0001–0.001 mm, while the pressure in the chamber was varied at will from 0.001 to 1.5 mm. The latter pressure was adjusted until the radius of the vessel was just greater than the range of the electrons used, and the number of electrons which passed into the chamber and the number of positive ions produced by them were measured with a quadrant electrometer. This was done at frequent voltage intervals as the accelerating voltage between the filament and the anode was raised to 1,500 volts, and a graph was made of the number of ions produced per electron plotted against the energy of the electrons expressed in volts.

Bohr's theory considers both primary and secondary ionizations and predicts that, for a gas with a single ionization potential, ionization will set in when the energy of the colliding electron expressed in volts is equal to this potential. The average ionization produced per unit path will rise rapidly to a maximum at twice the ionization potential and then decrease slowly; for gases with several ionization potentials the position of the maximum is shifted to higher voltages. R. H. Fowler[2] has shown that a numerical factor of approximately three fourths should be introduced in the Bohr equation when the distribution of the velocities of emission of the secondary electrons is taken into account. The theory also predicts sudden breaks in the ionization curves when the accelerating voltage becomes equal to large ionization potentials compared to which the other potentials are small. This should occur in air at potentials belonging to electrons on inner rings of argon, nitrogen and oxygen. Assuming that all the energy of the electron

[1] Bohr, N., *Phil. Mag.*, *25*, 101 (1923); *30*, 581 (1915).

[2] Fowler, R. H., *Proc. Camb. Phil. Soc.*, 21, 521, 531 (1923).

will be used in ionizing collisions Bohr has derived an expression for the range of the electrons, which for small velocities gives a fourth-power relationship between the velocity of the electron and its range, with a deviation from this law when the ratio of its velocity to the velocity of light is not negligible.

An examination of the experimental curve obtained has shown that ionization of air by electrons sets in at about 17 volts, the ionization potential of the nitrogen molecule, and rises rapidly to a maximum between 125–130 volts, a value in agreement with Mayer's[3] determination of this maximum which is due to primary ionizations. The curve rises again when secondary ionization starts near 170 volts, and sudden breaks in the curve occur at approximately 250 volts, 375 volts and 500 volts, the ionization potentials of the L-electrons of argon and the K-electrons of nitrogen and oxygen. These potentials are in agreement with the values obtained in the X-ray and photoelectric experiments of Kurth,[4] and Mohler and Foote[5] with nitrogen and oxygen, and in the recent ionization experiment of ughes and Klein[6] with argon. In this region the efficiency of ionization is never more than 20 per cent., as also has been observed by Hughes and Klein.[6] Above 550 volts ionization increases rapidly until near 1,000 volts the rate of increase becomes steady. Determinations of total ionization have been made up to 1,500 volts.

For a number of voltages the critical pressure for which the radius of the chamber was equal to the corresponding range of the electron was measured, and a graph shows that a good linear relation exists between the energy of the electron expressed in volts and the square root of the corresponding critical pressure. The slope of the line leads to the following form of the voltage-range law for low-speed electrons, where V is given in volts, and R is measured in cm at 760 mm pressure:

$$V = 16300 \sqrt{R}$$

In other words, this is another verification of the fourth-power relationship between the velocity and range of an electron, first experimentally verified by Whiddington.[7]

In his recent cloud experiments C. T. R. Wilson[8] has measured the length of ionization tracks which are probably due to electrons of 7,700 and 8,600 volt energies, from which he has deduced a value of 21,000 for the coefficient in the voltage-range equation. For such voltages the variation of the mass of the electron with its velocity is not negligible and becomes large in the range of velocities used in the absorption experiments of Schonland[9] with cathode rays, and Varder[10] with β-rays. Their results lead to a determination of the coefficient which varies from 22,000 to 7,000 as the velocity of the particle increases. As Fowler has pointed out the value of the coefficient as predicted by the Bohr theory for low velocities, about 7,000, should be multiplied by a numerical factor of 2 or 3.

By use of the above experimentally determined law and the average value of the total ionization produced by electrons at the various energies used in the experiment, the average ionization per cm of path at 1 mm pressure was calculated and the resulting graph gave a sharp maximum near 990 volts with an expenditure of about 24.1 volts of energy per ion pair, which is approximately the value predicted by Fowler and slightly less than that determined by Wilson at higher voltages. It appears that for high voltages primary ionization of air consists of the emission of the K-electrons of the oxygen atom and that secondary ionization is due to the emission of the L-electrons from nitrogen.

It is possible to compare the values for the ionization produced by the highest speed electrons used in the experiment with the results obtained by Glasson[11] with hard cathode rays. For voltages beyond 1,000 the total ionization increases at a steady rate, so that by extrapolation and by use of the voltage-range equation a value of 1.43 ions per cm has been calculated for 4,000-volt electrons, as compared with the value, 1.5, determined by Glasson at this voltage.

It has seemed advisable to make a short preliminary report of the results of this experiment which verify the Bohr theory of ionization as corrected by Fowler, since the publication of the detailed description of the experiment may be delayed by an attempt to extend the range of voltages used in the experiment.

In conclusion, the author wishes to acknowledge her indebtedness to Professor A. F. Kovarik, who suggested the experiment and gave her much valuable advice.

GLADYS A. ANSLOW

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THE REACTIVITY OF LIQUID PHOSGENE[1]

MODERN inorganic chemistry has developed around the so-called "universal solvent," water, and most of our chemical ideas have been formed with reference to the more common aquo-acids, bases and salts, and their behavior towards water. That this particular chemistry is, however, only a special case of a broader universal chemistry has been shown by E. C. Franklin in his brilliant conception and demonstration of the existence of an entire series of ammono-acids, bases and salts, many of which are entirely incapable of existing in the presence of water, but whose behavior towards liquid ammonia, solubility, conductivity of their solutions, formation of ammoniates, ammonolysis, etc., parallels the behavior of aquo-compounds towards water in a truly remarkable manner; in fact, ammonia enjoys the distinction of being an even more perfect solvent than water, in that it forms conducting solutions of numerous metals (alkali and alkaline earth metals) in which the anion is the electron itself, associated with ammonia, and in that it dissolves a host of organic compounds insoluble in water.

One naturally inquires why this sort of thing should be restricted to water and ammonia, and why other liquids—or liquid gases or even melted solids—should not also form the basis of a hitherto unknown chemistry. Liquid silicon dioxide, while a derivative of water, may nevertheless be looked upon as such a substance, and we may expect as one of the results of the recent success in the preparation of large amounts of liquid silica a large increase in our knowledge of the chemistry of the silicates; the laboratory of geochemistry and the workers in the glass industry have of course already made notable contributions in this field. Among the liquid gases that have been investigated along this line, such as hydrogen sulfide, hydrogen fluoride, hydrogen chloride, etc., more or less insurmountable obstacles oppose themselves—hydrogen fluoride attacks our customary apparatus, though there is no reason why the optically clear Bakelite developed some years ago should not be used in the pursuit of this subject; hydrogen sulfide, hydrogen chloride and many others, on the other hand, refuse to dissolve anything, and so prevent us from continuing the study.

Among these other substances, one that is important commercially because of its use in the preparation of certain organic compounds and in the synthesis of anhydrous chlorides from minerals, and is therefore readily obtainable, is phosgene, or carbonyl chloride, $COCl_2$, known since 1811, when it was discovered by John Davy, brother of the illustrious Sir Humphry. Phosgene may be looked upon as the acid chloride of carbonic acid, and in its reactions it behaves in this way. It is an excellent solvent for organic compounds; as an acid chloride it is very reactive in this field, and being an easily condensible gas (it boils at 8° C.) and very soluble in benzene and toluene, it may be used as a pure liquid, as a gas or as a solution in any one of a variety of solvents. At high temperatures it is likewise very reactive—probably because it dissociates, giving carbon monoxide and chlorine, and it has been found possible to open up difficult minerals by its use, to prepare anhydrous chlorides from the oxides, etc. But liquid phosgene is practically inert towards inorganic compounds and the metals. Sodium, potassium, calcium, magnesium, even mercury, remain perfectly bright in liquid phosgene, even after prolonged exposure, except as already mentioned at elevated temperatures. Among inorganic compounds, the chlorides of the non-metals and of the metalloids and aluminium chloride are soluble in liquid phosgene.

The solution of aluminium chloride in phosgene has important properties: metals are corroded or dissolved by this solution, with liberation of carbon monoxide; metallic oxides, carbonates and sulfides are attacked, with liberation of carbon dioxide or carbon oxysulfide, as the case may be, and in certain cases the solid product of the reaction is soluble, so that the reaction goes on vigorously. The solution contains a more or less soluble chloraluminate of the metal used, which may be more or less dissociated into aluminium chloride and the chloride of the other metal; on evaporation of the solvent, or on cooling the solution, crystals of a chloraluminate containing phosgene of crystallization are deposited; for example, the calcium salt has the formula $CaAl_2Cl_8 \cdot 2COCl_2$.

The explanation is simple, and entirely analogous to the mechanism of the solution of aluminium or zinc by a water solution of sodium hydroxide; *phosgene is fundamentally reactive,* but the chlorides of most metals are entirely insoluble; the double chlorides with aluminium, the chloraluminates, on the other hand, are much more soluble, and the protective film of chloride which forms on the surface of the metal, oxide, carbonate or sulfide is dissolved in the presence of aluminium chloride as chloraluminate, and the reaction proceeds.

There is no *a priori* reason why other types of soluble complex salts should not exist, not only in the case of phosgene, but for other solvents. And the chemistry of these systems simply awaits the discovery of the type of compound peculiar to the system which is soluble enough to permit the inherent reactivity of the solvent to manifest itself.

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CALIFORNIA

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THE AMERICAN CHEMICAL SOCIETY[1]

DIVISION OF ORGANIC CHEMISTRY

R. R. Renshaw, *chairman*

J. A. Nieuwland, *secretary*

The relative reactivities of the hydroxydehydrogen atoms of certain alcohols: JAMES F. NORRIS and A. A. ASHDOWN. The rates at which several alcohols react with p-nitrobenzoyl chloride in ether solution were determined. The second order velocity constant of methyl alcohol at 25° C. was 0.184. Taking this value as 100 the other alcohols give the following numbers: Ethyl 45.0, n-butyl 40.2, n-propyl 35.9, beta-phenyl-ethyl 21.6, isobutyl 16.7, alpha-phenyl-prophyl 10.7, benzyl 9.3, isopropyl 5.4, secondary butyl 4.0, tertiary butyl 1.46. The significance of these numbers will be discussed.

The dissociation into free radicals of derivatives of dixanthyl: J. B. CONANT and A. W. SLOAN. The salts of 9-benzylxanthenol on reduction with vanadous chloride yield dibenzylxanthyl, which, like diphenyldixanthyl, dissociates with the formation of a free radical. The molecular weight determinations in benzene indicate about 10 per cent. dissociation; the substance rapidly absorbs oxygen, forming a peroxide. Dibutyldixanthyl prepared in a similar manner shows none of the characteristic reactions of a free radical, and like the parent substance dixanthyl appears to be undissociated, although it absorbs oxygen very slowly. The influence of the benzyl group in causing dissociation is of interest in connection with the problem of the stability of trivalent carbon compounds.

A comparative study of the Kjeldahl-Gunning-Arnold and boric acid method for the determination of nitrogen: KLARE S. MARKLEY and RAYMOND M. HANN. The paper summarizes a series of experiments designed to show that the boric acid method, which utilizes a 4 per cent. solution of boric acid as an absorption medium for the liberated ammonia following its conversion to $(NH_4)_2SO_4$ by digestion with sulfuric acid containing 10 per cent. P_2O_5 and subsequent release with an excess of alkali, is equally as accurate as the official Kjeldahl-Gunning-Arnold method of the A. O. A. C. Tables will be shown giving comparative results on soils, solutions, alkaloids and organic compounds; a discussion of the indicators used and the advantages of the boric acid method in regard to economy of time, materials and standard solutions will also be given.

The ketenic decomposition of the ketones: CHARLES D. HURD and WILLIAM H. TALLYN. The optimum conditions for the preparation of ketene from acetone have been ascertained. Consistent yields of 35 per cent. are obtainable, and yields considerably higher than this have been obtained. Acetyl acetone, pinacoline and diacetyl have all been subjected to pyrogenic decomposition. Theoretically these represent three very interesting types, when the possibilities of ketene fission are considered.

[1] Ithaca Meeting, September, 1924.

The beta-chlorovinyl arsine reaction and further derivatives: W. LEE LEWIS and H. W. STIEGLER. As previously published (*Jour. Ind. and Eng. Chem.*, March, 1923) it is believed that the catalyst complex in this reaction is $Al(CHCl=CHCl)_3As$, formed first by the addition of three moles of acetylene to one of aluminum chloride with subsequent addition of dissociated arsenic chloride to this. If this is correct then the halogen on the arsenic will determine the halogen in the final arsine after the intermediate compounds are hydrolyzed. Experimentally it was found that arsenic bromide gave bromo arsines, and arsenic chloride gave chloro-arsines, regardless of whether aluminum bromide or chloride was used. The study is being extended to the action of mercury halides in catalyzing unsaturated reactions. Among the derivatives of the chloro-vinyl arsines prepared were: Beta-chloro-vinyl-arsenious sulfide; 7-beta-chloro-vinyl-7, 12-dihydro-gamma-benzo-phenarsazine; bis-beta-chloro-xinyl cyanide (and sulfide); bis-beta-chlorovinyl-methyl (and ethyl) arsine; tris-beta-chlorovinyl-methyl-arsonium iodide.

The preparation of alpha oxy-indole propionic acid and its halogen derivatives: E. C. KENDALL and A. E. OSTERBERG. Alpha oxy-indole propionic acid is prepared from its hydro derivatives by oxidation in glacial acetic acid followed by reduction of the resulting bromo derivatives with sodium amalgam in alkaline solution. It is precipitated from the alkaline solution by acids. It can not be reduced with sodium amalgam to the di and tetra hydro derivatives. In water it adds on bromine to the N, which then migrates to No. 6 carbon. More bromine will give the 4, 6, dibromo. With excess bromine it will take up seven bromine atoms. The relation of these compounds to thyroxin will be discussed.

Some condensation products of furfural: S. A. MAHOOD and S. B. JORDAN. Heating furfural with benzene in the presence of zinc chloride causes polymerization of the furfural into a solid. Unlike the condensation of benzaldehyde with benzene which forms triphenyl-methane, no evidence of the analogous compound, diphenyl-furyl-methane, was found. From the data obtained the product is a polymer of furfural. Phosphorous halides give a similar product rather than fural halides. Furfural with phenyl-magnesium-bromide yields an addition product which with water gives an unstable oil which is apparently phenyl-furyl-carbinol. All attempts to esterify it, however, were unsuccessful and led to polymerization products.

The relation between the structure of organic halides and the reactivity of the halogen atom: J. B. CONANT, W. R. KIRNER and R. E. HUSSEY. The velocity constant of the reaction $RCl + KI \rightarrow RI + KCl$ in absolute acetone has been measured. The temperature coefficient of the reaction seems to be nearly the same for all substances studied. Ethyl chloride is about 2.5 times as reactive as n-propyl chloride, normal chlorides of higher molecular weight have about the same reactivity as propyl and butyl chlorides; secondary and tertiary halides are less reactive. The influence of so-called negative

groups such as C_6H_5, C_6H_5CO, CN, etc., can be expressed by the equation:

$$2 \log R = \log K_A - \log K_{H_2O} = \log K_{NH_3} - \log K_B,$$

where R is the relative reactivity of RCH_2Cl referred to butyl chloride, K_A the dissociation constant of AOH as an acid, and K_B the dissociation constant of ANH_2 as a base.

Positive halogen in organic compounds. II—The propinyl halides: LLOYD B. HOWELL and GAYLORD JOHNSON. Satisfactory methods have been found for preparing $CH_3-C\equiv C-Br$ and $CH_3-C\equiv O-Cl$. Failure of previous workers using methods successful for $CH_3-C\equiv C-I$ (halogenating silver allylide suspended in water) was probably due to interfering oxidation and halogenation of the triple bond. Preliminary study of these propinyl halides and also review of Nef's work with $CH_3-C\equiv C-I$ indicates his conclusion that compounds of type $R-C\equiv C-X$ are non-toxic, unexplosive and generally unreactive (in contrast to type $X-C\equiv C-X$) is not justified. Chloro-allylene and bromo-allylene are as pronouncedly nauseating, toxic, spontaneously inflammable and chemo-luminescent as are the halogen substituted acetylenes. Reactions of the propinyl halides indicate distinct positive polarity of the halogen atom present.

A modification of organic combustion analysis adapted to volatile liquids (Lantern): L. M. DENNIS and F. E. HANCE. In the analysis for carbon and hydrogen the usual train of reagents and combustion tube containing copper oxide are used. Suction is applied at the exit of the train, the copper oxide is heated, the sample in a small, sealed tube, having a constricted neck, is dropped in a U tube placed in the chain at the entrance of the combustion chamber. The neck of the sample tube is broken by a glass rod, the stopper being quickly replaced. An electrically heated oil bath is used to maintain the sample at about 20° below its boiling point, the vapor picked up by air, passing by a long thin tube, through the combustion tube, directly to the heated copper oxide. Condensation of the sample in the cooler portions of the combustion tube is prevented by a secondary stream of air which is drawn into the tube at the forward end.

Some interesting facts concerning the ultra-violet absorption spectra of certain organic compounds (Lantern): HELEN L. WICKOFF, C. E. BOORD and A. W. SMITH. The ultra-violet absorption of benzene, monobromobenzene, paradibrombenzene, monochlorobenzene, paradichlorobenzene, cyclohexene, 1-methylcyclohexene, 3-methylcyclohexene, diethylether, dinormalpropylether, dinormalbutylether, methylnormalamylether and other related derivatives have been studied in a comparative way. The complexity of the ultra-violet absorption pattern of these derivatives seems to be a function of the molecular symmetry. The absorption patterns of all these substances are very similar and certainly can not, in some cases, be attributed to the oscillation of double bonds.

Thymolsulfonephthalein, the intermediate acid (p-hydroxy-m-isopropyl-o-methyl-benzoyl benzene-o-sulfonic acid) and some of their derivatives: W. R. ORNDORFF and R. T. K. CORNWELL. Preparation of thymolsulfonephthalein and dithymyl-o-sulfobenzoate from the chlorides of o-sulfobenzoic acid and thymol. Preparation of thymolsulfonephthalein and the intermediate acid (p-hydroxy-m-isopropyl-o methyl-benzoyl benzene-o-sulfonic acid) from the anhydride of o-sulfobenzoic acid and thymol. Action of ammonia on the intermediate acid, its barium salt and the dibenzoate. Conversion of the intermediate acid by heat alone and by heating with thymol into thymolsulfonephthalein. Action of ammonia on thymolsulfonephthalein. The monosodium and disodium salts of thymolsulfonephthalein, the diacetate, the dibenzoate, the dimethyl ether, the aniline derivative. Dibromothymolsulfonephthalein and its diacetate.

The chemistry of Jaffe's reaction for creatinine. II—The effect of substitution in the creatinine molecule: ISIDOR GREENWALD. In a previous publication, it has been shown that Jaffe's reaction for creatinine is due to the formation of red tautomer of creatinine picrate. The following derivatives of creatinine do not give the reaction: dimethylolcreatinine, benzylidine acetylcreatinine, *benzylidine creatinine and tribenzoylcreatinine.* Reduction of benzylidenecreatinine with zinc and acetic acid gives a solution which gives Jaffe's reaction and from which *benzyl creatinine picrate* was isolated. Jaffe's reaction is given by methylcreatinine, benzoylcreatinine and methylglycocyamidine (isocreatinine). There appear to be two forms of benzoylcreatinine. (Substances italicized are new.)

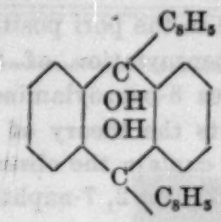
Ketene in the Friedel and Craft's reaction: CHARLES D. HURD. Ketene, in the presence of aluminum chloride, will convert several types of aromatic compounds, such as benzene, anisole, naphthalene, etc., to ketones. A mixture of ketones nearly always results, and it seems that in many cases more than one "$-COCH_3$" group is introduced. Ketene forms a white addition compound with aluminum chloride, suspended in CS_2. When aromatic compounds are added to it, HCl is evolved and ketones are formed as before.

The preparation of di and tetra-hydro oxy-indol propionic acid: E. C. KENDALL and A. E. OSTERBERG. 1-alpha-glutaric acid 2-keto-cyclohexane reacts with ammonia in absolute alcohol to form tetra-hydro alpha oxy-indol propionic acid. In glacial acetic acid bromine oxidizes this to 3, monobromo-5, 6, di-hydro alpha oxy-indol propionic acid. The properties of these two derivatives of alpha oxy-indol and their relation to thyroxin will be discussed.

Derivatives of 3, 4-diamino-phenyl-arsonic acid: W. LEE LEWIS and H. S. BENT. The study had for its main objective, which was achieved, the preparation of the arseno compound of sulfoxilated tryparsamide ($As\,C_6H_3(NH\,CH_2\,CONH_2)NH\,CH_2-OSONa)_2$. A preliminary study of the stability of the arsonic radicle to heat was necessary, as well as the reactivity of the diamino-phenyl-arsonic acid to various aliphatic and aromatic acid chlorides, chloro-carbonates, alcohols, etc. Of interest

are: N-(Phenyl-1-amino-4-arsonic acid) glycineamid; 1, 2-dihydro-3-amino-6-arsono quinoxaline; 1, 2-dihydro-3-hydroxyethylamino-6-arsonoquinoxaline; N-(phenyl-4-arsonic acid) amino malonamide; 1, 2-dihydro-2-formamide-3-amino-6-arsono quinoxaline.

9, 10-diphenyl anthracene: LLOYD B. HOWELL and E. E. DUNLAY. Attempted inner dehydration of:



resulted in reduction to 9, 10-diphenyl anthracene, a bright yellow solid. When, however, this hydrocarbon is made by method in literature (reduction of above diol by KI) a white solid results. Both forms melt alone or mixed at 261°, oxidize directly to original diol, upon chlorination give the same 9, 10-dichloro compound, but by no physical process could either modification be changed to the other. No adequate explanation of such two forms of 9, 10-diphenyl-anthracene is evident. The original diol made from anthraquinone and phenyl magnesium bromide (yield 10 per cent. in older literature m. p. 240–1° and 247°) was produced in yields of 80 to 90 per cent. of high purity (m. p. 263°) by merely adding a solid solvent for anthraquinone.

A new technique for preparing and handling zinc diethyl: L. M. DENNIS and F. E. HANCE. This article deals with a new method of preparing, purifying and handling zinc diethyl. Due to its spontaneously inflammable character, this reagent is handled in a closed chain of apparatus in a stream of carbon dioxide. Reaction is brought about between a zinc-copper couple and ethyl iodide. During this reaction ethyl iodide is refluxed against a slight pressure of carbon dioxide, this portion of the apparatus being vented to the room through a mercury trap. The product, zinc ethyi iodide, is converted to zinc diethyl and is passed along the apparatus by distillation from the zinc-copper reaction mixture. By fractional distillation the product is purified and the constant boiling alkyl is delivered to receptacles for further treatment, while the lower and higher boiling portions are diverted to another container in the chain. These operations are conducted in their proper sequence without exposing the alkyl to room air. The variations of gas pressure during the refluxing operation, in subsequent distillations and in the movement of the alkyl through the train, were all controlled by a series of simple mercury traps, by-pass connections and a vacuum oil pump. The entire apparatus may be readily constructed from ordinary laboratory material.

Some derivatives of p-hydroxy-methyl benzoic acid: F. H. CASE. In the esters of p-hydroxy-methyl benzoic acid, the local anesthetic effect of benzyl alcohol should be combined with that of aromatic esters in general. The object of this work has been the synthesis of such esters and some of their derivatives. p-hydroxy-methyl benzoic acid has been synthesized by a new and convenient method. Its ethyl, propyl, butyl, isobutyl and benzyl esters have been prepared, as well as the urethane, phenyl urethane, benzoyl and amino benzoyl derivatives of the ethyl ester. The benzyl and diethyl amino ethyl esters of p-ethoxy-methyl benzoic acid are described.

The two crystalline forms of glycine: C. A. BRAUTLECHT and W. W. PURDY. The results of a large number of experiments are given to determine whether any difference exists between the needle and plate forms of glycine when treated with sulfur dioxide alone, and in the presence of water-free liquids, carbon disulfide alone and in the presence of water-free liquids and acetyl chloride. As in the experiments with hydrogen chloride and bromine (C. A. Brautlecht and N. F. Eberman, *J. A. C. S.*, 45, 1924), using all means possible, no chemical difference between the two forms can be detected. Water brings about an equilibrium between the two forms and sulfur dioxide, carbon disulfide and acetyl chloride react with glycine only in the presence of water or atmospheric moisture.

The addition compounds of di-bromo-o-toluidine with metallic salts: RAYMOND M. HANN and G. C. SPENCER. A series of addition compounds prepared to study the effect of certain metals in organic combination upon the determination of nitrogen by the boric acid method. Di-bromo-o-toluidine combines with $HgCl_2$, $ZnCl_2$, $CdCl_2$, $CdBr_2$ and certain other metallic compounds to give derivatives of the type $2\,C_6H_2(CH_3)(Br_2)NH_2 - MX_2$. Antimony trichloride combines in the ratio 1:1. Comparison of results for nitrogen determination shows the boric acid method applicable to this class of compounds.

Nitration from a physical-chemical viewpoint: P. M. GIESY. Since the addition of sulfuric acid to a mixture of water and nitric acid raises the vapor pressure of the nitric acid, it must also raise the concentration of nitric acid dissolved in any immiscible liquid in equilibrium with the mixture and should therefore aid in the nitration of such a liquid. The suggestion is made that all mixed acids having equal vapor pressures of nitric acid should behave the same in nitrating, unless sulfuric acid dissolves sufficiently in the organic liquid to lower the vapor pressure of nitric acid from it.

The crystallography and optical properties of substituted 3-methoxy-4-hydroxy-benzaldehydes: RAYMOND M. HANN and EDGAR T. WHERRY. The crystallography of a series of substituted 3-methoxy-4-hydroxy-benzaldehydes is discussed from the chemical side. The effect of atomic volume upon crystal structure is pointed out. Topic axes are calculated and the resultant data included. Finally the optical properties of the derivatives are tabulated and a scheme for their separation and identification by optical means appended.

Reactions of divinylacetylene: J. A. NIEUWLAND. Reactions of divinylacetylene that gives additional proof of the formula ($CH_2 \equiv CH - C \equiv C - CH = CH_2$) of this acetylene polymer have been worked out. A tetrabromide has been prepared and purified (M. P. 87°). A hexa-